Intel Establishes New Transistor Performance Record

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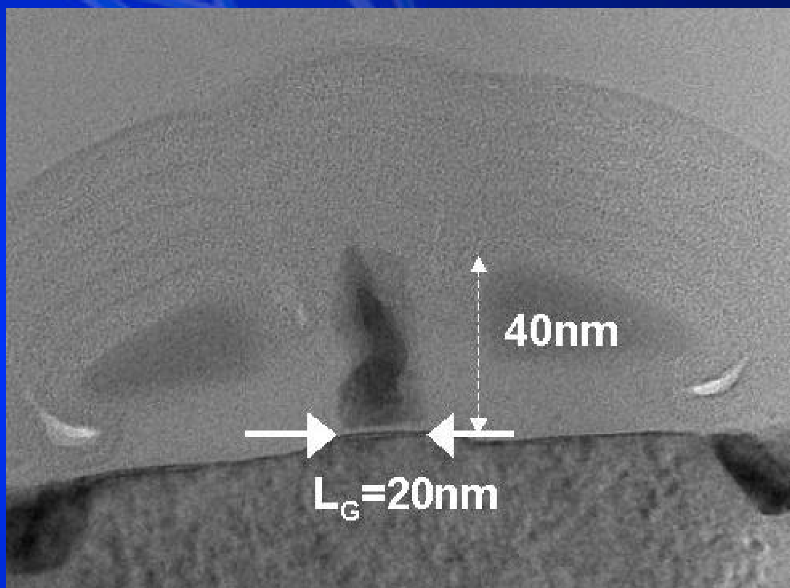
What are we announcing?

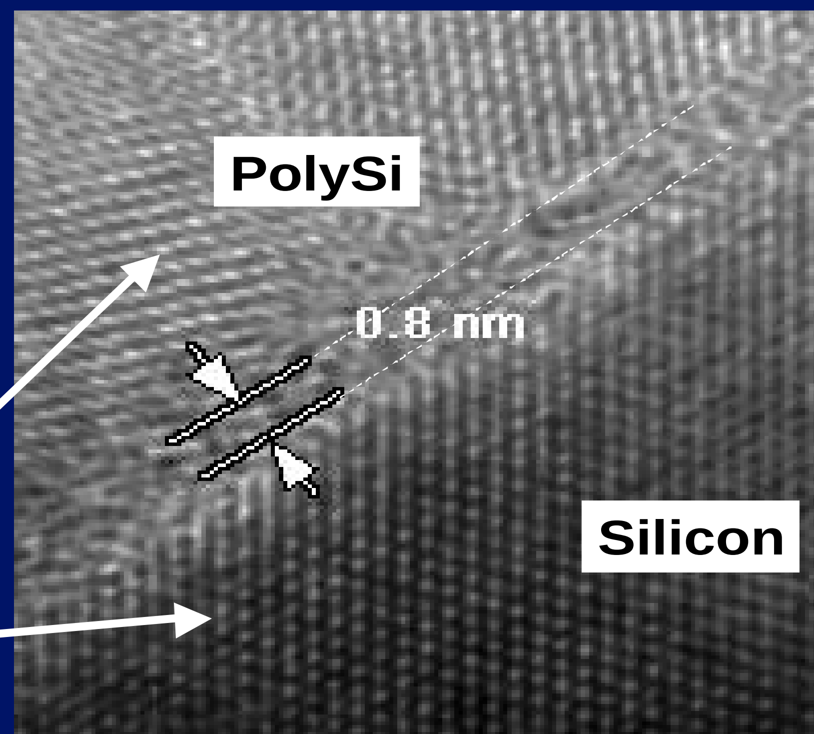
- Intel Labs researchers have developed the world's *fastest* silicon transistor
- These transistors are only 20 nanometers (nm) in size
  - Some structures are only 3 atomic layers thick!
- This development will lead to billion-transistor processors
- Intel's entry into nanotechnology is silicon-based

What do these transistors look like?



20 nanometer transistor

Gate oxide less than 3 atomic layers thick



Atomic structures

Why is this important?

- Building these transistors using current materials and transistor structures shows that we continue to see *no fundamental barriers to continue Moore's Law through the end of the decade* – innovation can continue at current pace
- Fast transistors are the foundation for fast processors and other silicon devices
  - Will enable microprocessors with close to *1 billion transistors* operating at about *20 GHz around 2007*
  - By comparison, Pentium® 4 processors have 42 million transistors
  - More transistors = more processor capabilities

What will you do with all that processing power?

- Create smarter computers that will be immensely more useful
- They will do things like:
  - Understand commands in “natural” language and handwriting
  - Look at how you work and anticipate what you will need to get your work done faster
  - Example: Do your holiday shopping in 5 minutes. Tell your computer what to buy (even show it photos of products you want). It goes on the Internet and does the shopping for you, while you do more useful things

What's Intel's silicon research goal?

- Continue to drive Moore's Law
  - 30% shrink in transistor size every 2 years
    - Delivers 2x die per wafer
    - Delivers 1/2 transistor cost
  - 30% transistor performance improvement
    - Delivers 2x speed
  - Low power/high speed applications
    - Avoid heat and power limits

What does that translate into?
A new process every 2 years

	Actual				Forecast			
Process Name	P854	P856	P858	Px60	P1262	P1264	P1266	P1268
1^{st} Production	1995	1997	1999	2001	2003	2005	2007	2009
Lithography (microns)	0.35	0.25	0.18	0.13	0.09	0.065	0.045	0.032
Gate Length (microns)	0.35	0.20	0.13	0.07	0.05	0.03	0.02	0.016

This work

Note: 0.02 micron = 20 nm

How can we continue to deliver technology breakthroughs?

- We have a technology edge
  - Research to development to manufacturing pipeline (including new research lab in Oregon—industry's first silicon research facility focused on 300mm wafers)
  - Smallest and fastest transistors in the industry
  - Advanced lithography expertise (including 157nm & EUV)
  - Voltage scaling for low power
  - High Volume Manufacturing
- We have a broad reach in R&D
  - Extensive internal research and development, complemented by programs with industry consortia, universities and national labs

Intel's silicon technology continues to lead the industry

What's next?

- We still have not found a fundamental barrier to extending Moore's Law

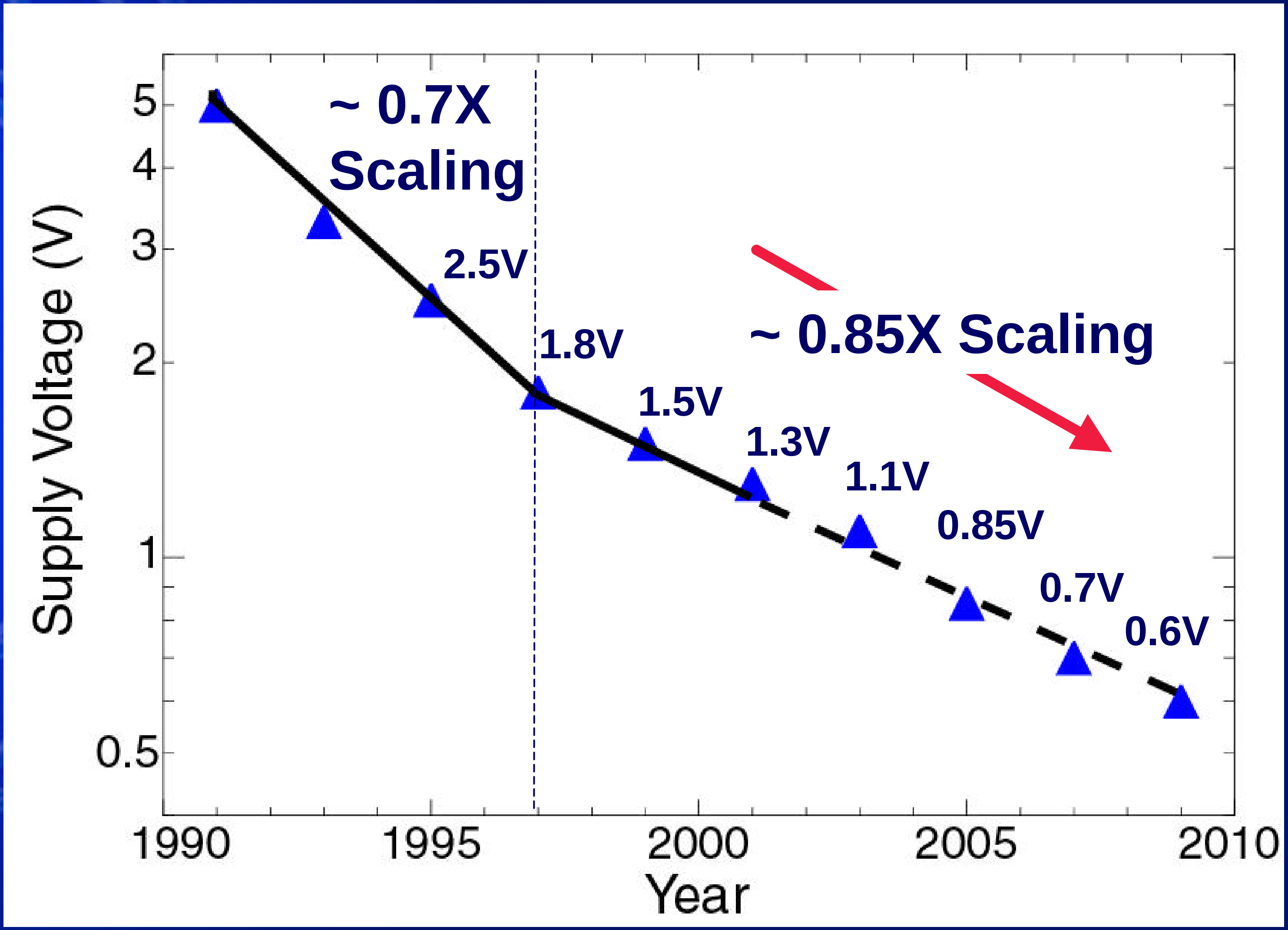
- Ongoing research includes:
  - 157nm and EUV Lithography
    - Continuing to shrink features through end of decade
  - New transistor materials
    - High k gate dielectrics
    - Low power & high speed
  - Novel interconnects and packages
    - High speed & bandwidth

To probe further

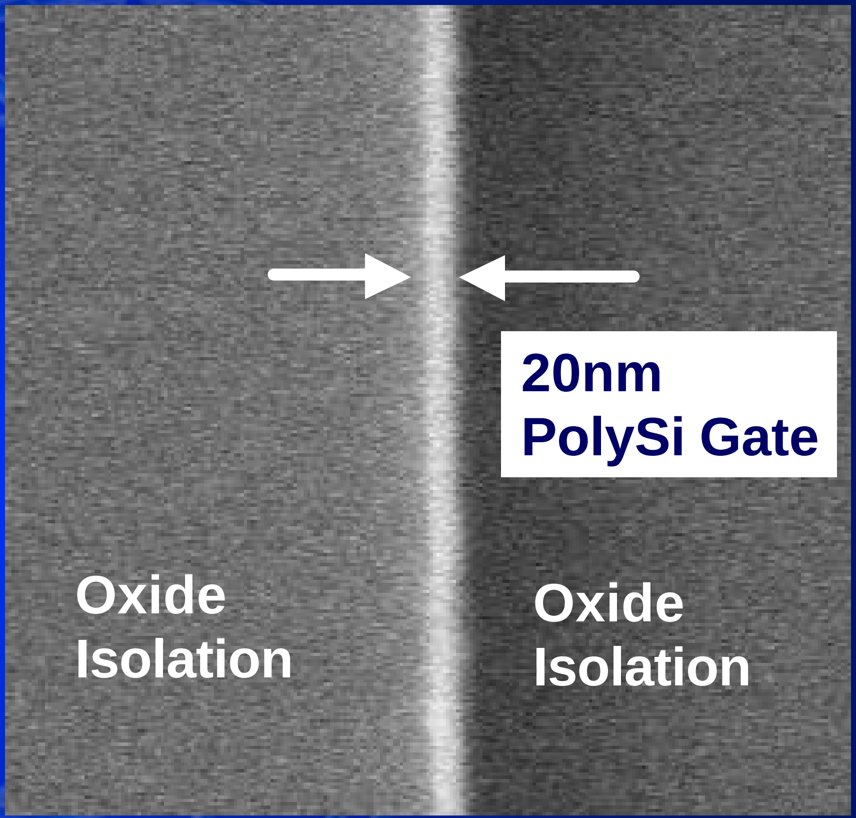
- For information on Intel's silicon technology, please visit the Silicon Showcase at www.intel.com/research/silicon
- More information on Intel’s new transistor records is being presented at the Silicon Nanoelectronics Workshop in Kyoto, Japan, June 10, 2001
- For more information on Intel Labs, please visit www.intel.com/labs

Backup

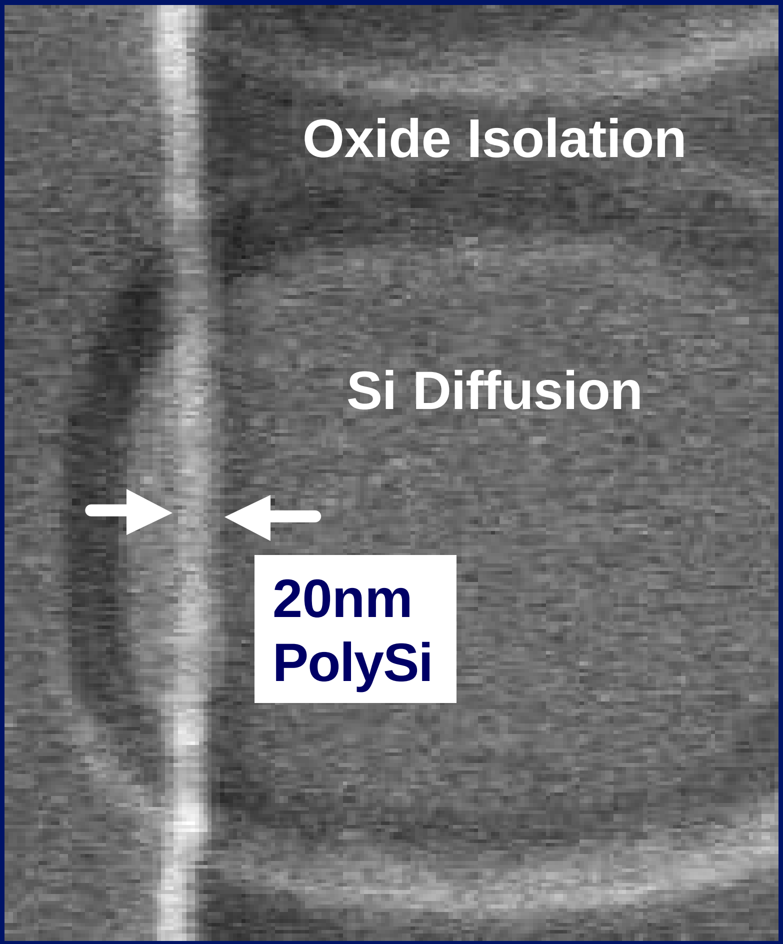
Supply Voltage Scaling Trend



20nm Physical PolySi Gate

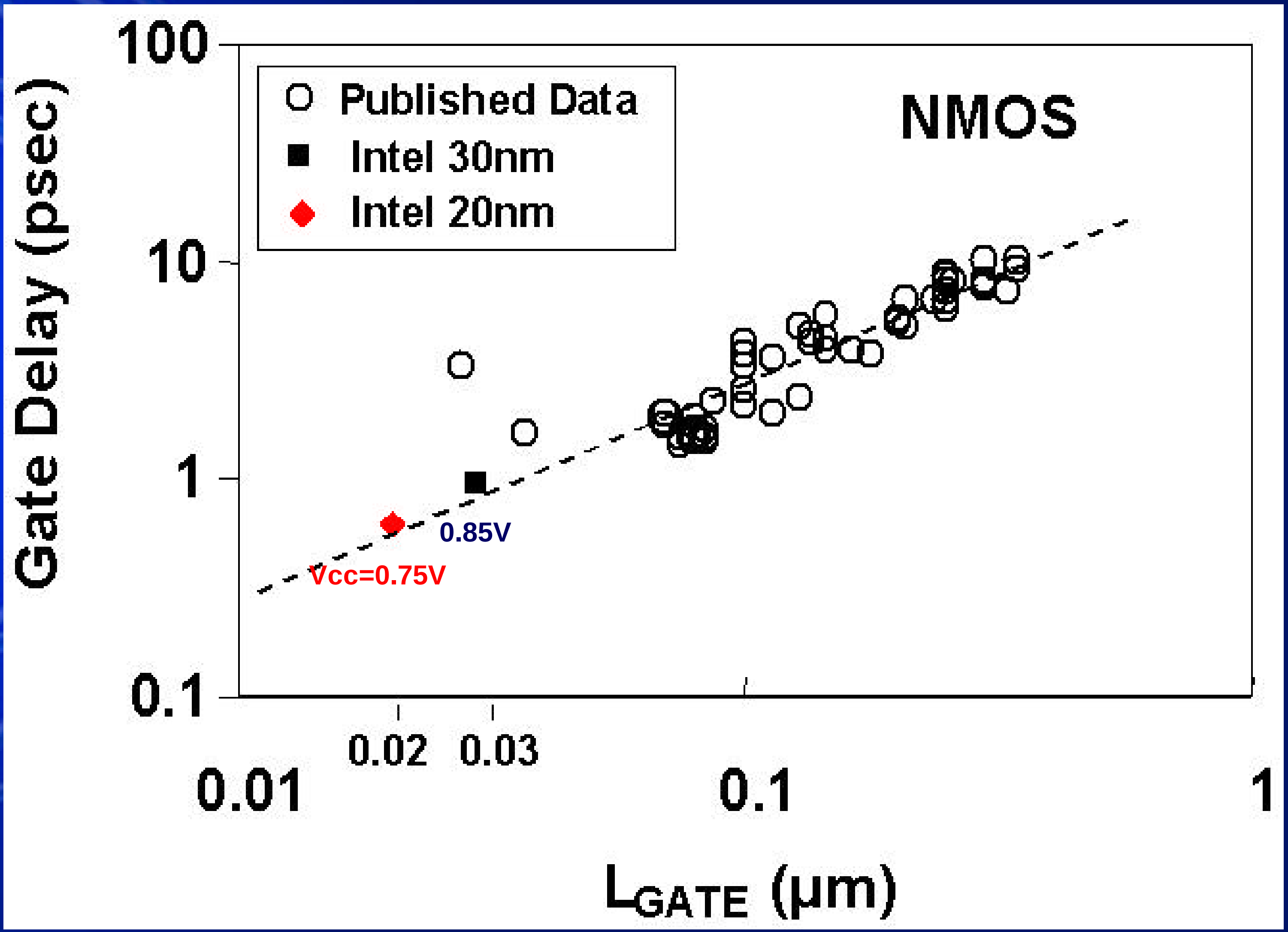


20nm polySi gate on oxide isolation

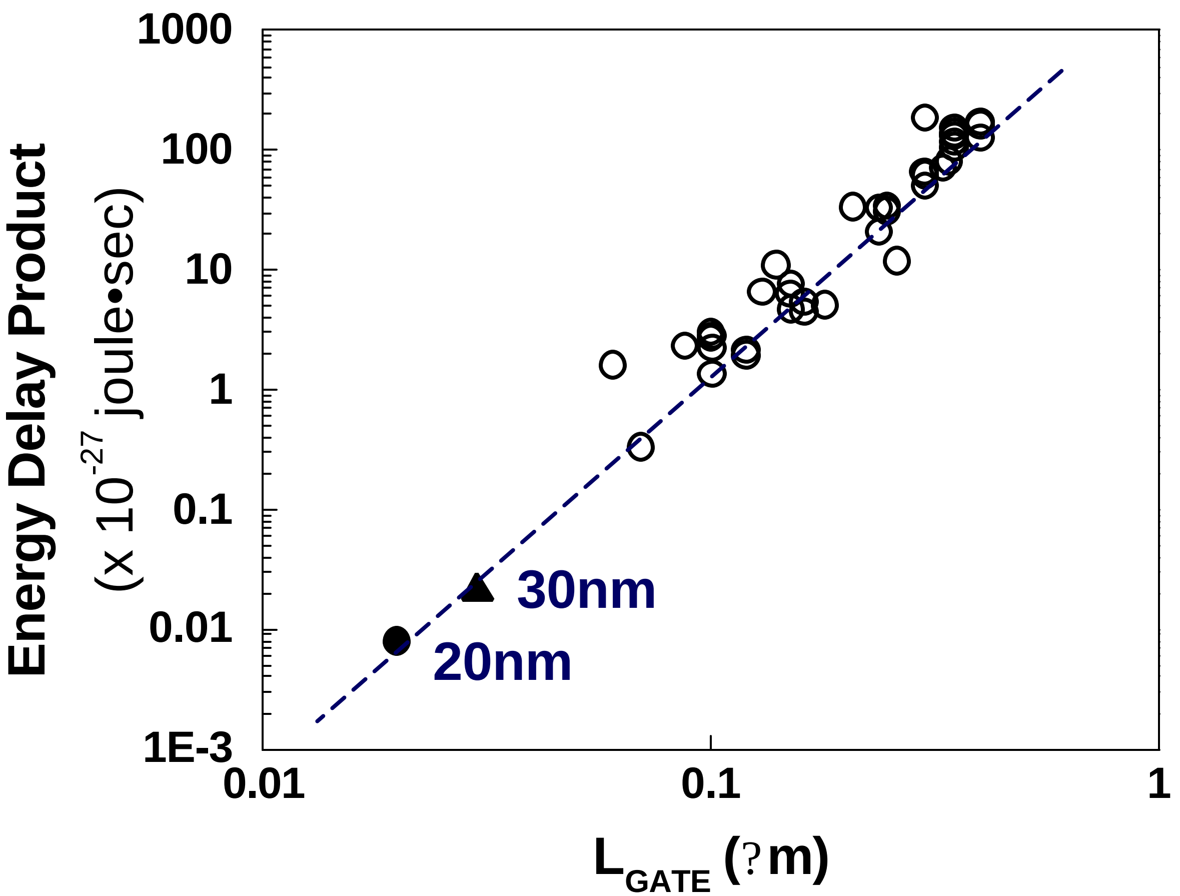


20nm polySi gate on oxide Isolation and Si diffusion

Gate Delay Trend Continues

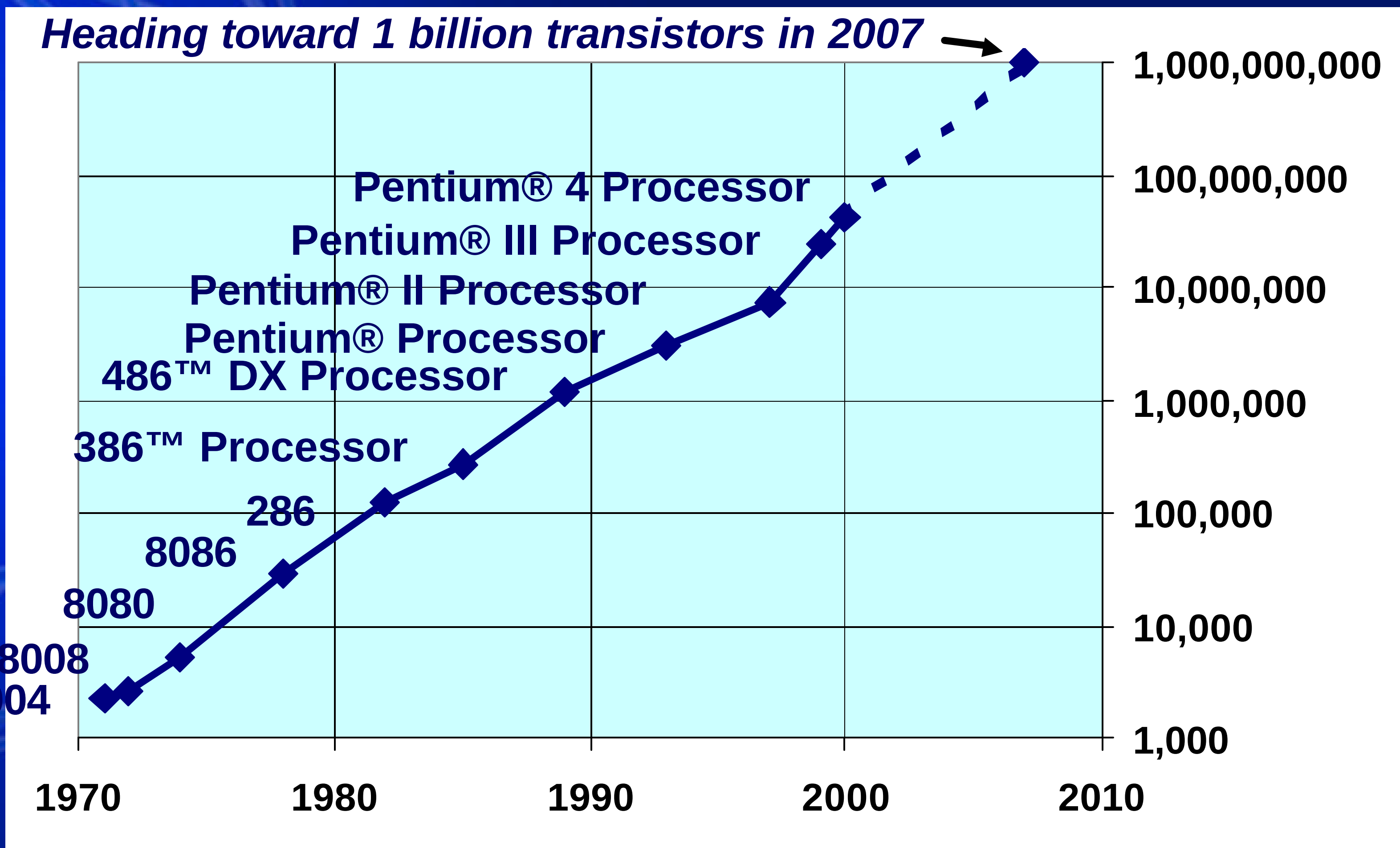


Energy Delay Product Trend Continues



Moore's Law Continues

Transistors doubling every 2 years toward the billion-transistor microprocessor



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